Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/35**

Paper 3 Advanced Practical Skills 1 **May/June 2019**

MARK SCHEME

Maximum Mark: 40

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

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Cambridge Assessment International Education

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Question	Answer	Marks
1(a)	**I** **All** thermometer readings are recorded to .0 or .5 °C.	**1**

Examiner to calculate Supervisor's maximum ΔT from table and candidate's ΔT from same volumes.

Calculate the difference between the two values.

$\Delta T = T_{max} - (T_{acid} + T_{alkali}) / 2$ (correct to 1 DP)

Question	Answer	Marks
1(a)	**II** Award this mark based on the tolerance table	**1**
	III Award this mark based on the tolerance table	**1**

Sup ΔT_{max}	> 16.0 °C	8.5–16.0 °C	4.5–8.0 °C	⩽ 4.0 °C
1 mark	δ = 2.0 °C	δ = 1.5 °C	δ = 1.0 °C	δ = 0.5 °C
2 marks	δ = 1.0 °C	δ = 1.0 °C	δ = 0.5 °C	not available

Question	Answer	Marks
1(b)(i)	**I** Linear scales chosen so that graph occupies more than half the available length for both axes (including extra 2 °C for *y*-axis). (*points on y-axis and 0–40 cm³ on x-axis occupying at least 5 large squares on x-axis and 6 large squares on y- axis)* **AND** axes labelled with name and / or unit	**1**
	II **All** points recorded (minimum 7 recorded) accurately plotted If the point should be on a line it must be on the line. If the point should not be on a line it must not be on a line and must be correct to within half a small square.	**1**
	III Two lines of best fit drawn (straight or smoothly curved lines) – one for increasing temperature and one for decreasing temperature. **Ignore** points marked anomalous	**1**
1(b)(ii)	Correct volume of **FA 2** read from the intersection (to within .25 cm^3 of examiner value) **AND** Volume **FA 1** = 40.0 – volume **FA 2** Volumes of **FA 1** and **FA 2** must be given to 1 dp **Allow discontinuity** for intersection. A continuous curve cannot score either mark **(b)(i)III** or **(b)(ii)**. Neither **(b)(i)III** nor **(b)(ii)** are available if there is no max T.	**1**
1(c)(i)	Correctly calculates $\frac{2.0 \times \text{Vol}(\textbf{FA 2} \text{ in } \textbf{(b)})}{1000}$ to 3 or 4 sf	**1**
1(c)(ii)	Correct expression $\frac{\textbf{(c)(i)} \times 1000}{\text{Vol}(\textbf{FA 1} \text{ in } \textbf{(b)})}$ **and** answer to 3 or 4 sf	**1**

Question	Answer	Marks
1(d)	Explain how to get ΔT (from graph or table) (T_{max} – initial T **or** T_{max} – average of initial Ts) **Allow** use **rise** in temperature.	**1**
	Use of $Q = mc\Delta T$	**1**
	Divide $^{\text{heat energy produced}} / _{\text{moles of alkali neutralised}}$ (moles of alkali neutralised = **(c)(i)**)	**1**

Question	Answer	Marks
2(a)	**I** The following data must be shown • burette readings **and** titre for rough titration • 2 × 2 'box' showing both accurate burette readings *'Correct' headings and units are **not** required for this mark*	**1**
	II Headings and units correct for accurate titration table and headings match readings. • initial / start **and** (burette) reading / volume + unit • final / end **and** (burette) reading / volume + unit • titre ***or*** volume / **FA 4** used / added + unit *Units: (cm^3) or / cm^3 or in cm^3 or cm^3 by every entry*	**1**
	III All accurate burette readings to 0.05 cm^3	**1**
	IV The **final** accurate titre recorded is within 0.10 cm^3 of any other accurate titre.	**1**

Question	Answer	Marks
2(a)	Award **V** if $0.50 < \delta \leqslant 0.80\ cm^3$	**1**
	Award **VI** if $0.30 < \delta \leqslant 0.50\ cm^3$	**1**
	Award **VII** if $\delta \leqslant 0.30\ cm^3$	**1**
2(b)	Candidate must average two (or more) titres that are **all** within $0.20\ cm^3$. Working must be shown **or** ticks must be put next to the two (or more) accurate titres selected.	**1**
2(c)(i)	Final answers to **(ii)–(iv)** to 3 or 4 sf	**1**
2(c)(ii)	Correctly calculates $\frac{0.0353 \times 25}{1000} = 8.825 \times 10^{-4}$	**1**
2(c)(iii)	Correctly calculates $8.825 \times 10^{-4} \times 2 = 1.765 \times 10^{-3}$ **Allow** ecf from **(c)(ii)**	**1**
2(c)(iv)	Correctly uses $\frac{\textbf{(c)(iii)} \times 1000 \times 250}{\text{volume in } \textbf{(b)} \times 10}$	**1**

Question	Answer	Marks
2(d)	**One** of: Experiment **1** is more accurate: **Intersection** (*allow extrapolation*) gives accurate max T **or** gives accurate **volumes** needed for neutralisation / calculation **or** Extra dilution step increases errors in titration values. **OR** Experiment **2** is more accurate: Acid diluted so 1 drop contains fewer moles so end point more precise **or** More precisely calibrated / smaller % volume error **and** in apparatus / pipette / burette for **FA 2** **OR** Both of equal accuracy because concentrations are very similar (in Experiments 1 and 2). **Reject** expt 2 is more accurate as heat is lost through the top of the cup. (*ΔT is in a range such that the heat energy loss is minimal in the time taken to complete the experiment*.)	**1**
2(e)	Correctly calculates M_r CH_3COOH = 60 **and** 60 × **(c)(iv)** (Default value = 124.8 g dm^{-3}) **or** 112.3 / 60 and compare with **(c)(iv)** (*112.3 / 60 = 1.87*) **or** 112.3 / **(c)(iv)** and compare with 60 (Default M_r = 54 / 54.0 / 53.99)	**1**

Question	Answer	Marks
	FA 5 = $FeCl_3$(aq); **FA 6** = H_2SO_4(aq); **FA 7** = $AgNO_3$(aq)	
3(a)	Award one mark for every two correct observations (*)	**10**

test	*observations*		
	FA 5	**FA 6**	**FA 7**
+ Na_2CO_3		effervescence / fizzing / bubbling *	off white / **pale** brown / cream ppt *
		gas / CO_2 turns limewater milky / chalky / cloudy white / forms white ppt *	
+ Mg		effervescence / fizzing / bubbling *	black ppt / black solid formed *
		gas / H_2 pops with lighted splint *	
+ $AgNO_3$	white ppt * Allow off-white ppt	no change / no (visible) reaction / no ppt *	no change / no (visible) reaction / no ppt *
+ NH_3	brown / red-brown / orange-brown / rust ppt *	Ignore	Ignore
+ $Ba(NO_3)_2$	no change / no (visible) reaction / no ppt *	white ppt *	no change / no (visible) reaction / no ppt * Ignore faint white ppt
+ HC*l*	Ignore	ppt insoluble * Allow no change	white ppt * Soluble in excess is CON
+ NaOH	brown / red-brown / orange-brown / rust ppt **and** insoluble in excess *	no change / no (visible) reaction / no ppt / temp increases *	(dark) brown / grey-brown ppt **and** insoluble in excess *
+ **FA 7**	white ppt * allow off-white ppt	no change / no (visible) reaction / no ppt *	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(b)</td><td>

	FA 5	**FA 6**	**FA 7**
cation	Fe^{3+} *	H^{+} *	Ag^{+} / unknown *
anion	Cl^{-} *	SO_4^{2-} *	unknown *

2 * = 1 mark (round down)</td><td>3</td></tr>
<tr><td>3(c)</td><td>precipitation reaction involving FA 5
$Fe^{3+}(aq) + 3OH^{-}(aq) \rightarrow Fe(OH)_3(s)$

or

$Ag^{+}(aq) + Cl^{-}(aq) \rightarrow AgCl(s)$</td><td>1</td></tr>
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